AN EXTENDED BOUNDARY NODE METHOD FOR MODELING DISCONTINUITIES

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The Boundary Node Method (BNM) was first proposed for two-dimensional (2-D) potential theory by Mukherjee and Mukherjee [1], and has since been applied to a variety of problems such as 2-D and 3-D elasticity [2]. The method combines the mesh-free advantage of Moving Least Squares (MLS) approximants with the dimensionality advantage of the BEM.

The BNM, as originally proposed, had two weaknesses. The first was that curvilinear surface co-ordinates, rather than Cartesian co-ordinates, were used. The second was that possible discontinuities in variables such as flux or traction, across corners or edges on the boundary of a body, were not modeled properly. Li and Aluru, in two recent papers [3,4], have addressed these two important issues. They have employed Cartesian co-ordinates in both these papers. The first approach [3], based on Hermite-type interpolation, also correctly models flux discontinuities (in the 2-D Laplace equation) across corners, at the expense of a significant increase in computational effort. Also, this work, at the outset, neglects the spatial variation of the coefficients (called $\mathbf{a}$) in the polynomial basis expansion for the normal derivative q (see equations (9-10) in [3]), but later allows $\mathbf{a}$ to vary in space. Their second approach [4] employs a variable basis that allows use of Cartesian co-ordinates in an elegant manner, but this time uses continuous approximants for q across corners, thereby failing to model possible jumps in this variable.

The current paper is an attempt to retain the elegance of the variable basis approach presented in [4] while overcoming its primary shortcoming, i.e. flux discontinuities across corners are now modeled accurately. This is done by choosing a suitable basis for q in "broken clouds", i.e. clouds that contain corners. The 2-D Laplace problem is addressed first, but the method can be easily extended to 3-D and to linear elasticity problems. Numerical results for selected examples demonstrate the efficacy of this new approach.

References

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